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CONTENTS

CRYSTALS AND SEMICONDUCTORS

LASERS AND MASERS

NUCLEAR PHYSICS

OPTICS AND SPECTROSCOPY

TRANSITION FROM GAPLESS SEMICONDUCTOR TO SEMICONDUCTOR TO METAL IN MERCURY TELLURIDE UNDER PRESSURE

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 23, No 10, Oct 81
(manuscript received 25 May 81) pp 3091-3094

SHCHENNIKOV, V. V. and GLUZMAN, N. G., Institute of Metal Physics, Ural Science Center, USSR Academy of Science, Sverdlovsk

[Abstract] A study was made of the electrical properties of HgTe over the 0-120 kbar pressure range. Specimens of HgTe single crystals with an electron concentration $n = 4.5 \cdot 10^{17}$ cm^{-3} were tested at T = 293 K in a "Toroid" steel chamber up to 50 kbar and in a chamber with VK-6 hard alloy inserts up to 120 kbar. The pressure scale was graduated according to phase transitions in HgSe (7.5 kbar), CdSe (23 kbar), Bi (25.4 kbar), Tl (36.7 kbar), Te (42 kbar), Bi (77 kbar). The temperature dependence of electrical resistivity at each pressure level was measured over the 290-370 K range in both heating and cooling directions. The test results, based on 10 specimens, reveal that electrical resistivity is almost independent of temperature in the $p \leq 15$ kbar range corresponding to the HgTe-I phase with zero energy gap and increases exponentially with temperature in the $p > 15$ kbar range corresponding to the HgTe-II phase with energy gap narrower than in Se but wider than in Te. The hexagonal HgTe thus belongs in the same group of semiconductors as group-IV elements and Te. The authors thank I. M. Tsidil'kovskiy for helpful comments. Figures 2, references 12: 3 Russian, 9 Western.
[68-2415]

STRUCTURAL PERFECTION OF InSb SINGLE CRYSTALS WITH GROWN P-N JUNCTION PRODUCED DURING ORBITAL SPACE FLIGHT

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 23, No 10, Oct 81
(manuscript received 20 May 81) pp 3043-3049

SHUL'PINA, I. L., SOROKIN, L. M., RAUKHMAN, M. R., ZEMSKOV, V. S., REGUBOVA, A. S., MOSINA, G. N. and KOZITSYNA, Ye. A., Physico-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] Single crystals of indium antimonide with a grown p-n junction were produced by the Bridgman process on board the Salyut-6 during its space flight. Their structure was then compared with analogs produced by the Czochralski process on earth. The specimens were doped with zinc in the p-region and with tellurium in the n-region. The results of electron-microscope examination and x-ray topogram analysis indicate that the process of oriented crystallization under orbital flight conditions can yield InSb single crystals with a neck region featuring a high degree of structural perfection, with a dislocation density of only 10-100 cm^{-2}. The only defects are coherent thin interlayers parallel to one another and perpendicular to the direction of crystallization, easily activated by point contacts and because of the nonwettability of the crucible walls by the melt. Figures 6, references 17: 14 Russian, 3 Western. [68-2415]

MECHANICAL CHARACTERISTICS AND PARAMETERS OF DISLOCATION DOMAIN STRUCTURE IN ALKALI-HALIDE CRYSTALS IN CREEP

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 23, No 10, Oct 81
(manuscript received 28 Apr 81) pp 2964-2970

SMIRNOV, B. I., CHUDNOVA, R. S. and SHPEYZMAN, V. V., Physico-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] The evolution of a dislocation structure in alkali-halide crystals during creep under tension was studied, of special interest being boundary effects and boundary migration. Experiments were performed with LiF crystals, also partly with NaCl crystals, grown by the Kyropoulos procedure. The specimens were annealed for 48 h at 1023 and 923 K respectively, then cooled at a rate of 5 K/h. Creep measurements revealed a steady stage with appreciable strain rate only at temperatures above 673 K in the case of LiF crystal and above 573 K in the case of NaCl crystals. At lower temperature either the strain rate decreased rapidly or the specimen fractured under load during the transient stage. The size distribution of dislocation domains as well as temperature and stress dependence of their structural parameters were also determined. The results are interpreted in terms of the relative magnitudes of the steady-creep activation energy and the ion spontaneous-diffusion energy. Figures 5, table 1, references 18: 8 Russian, 10 Western. [68-2415]

UDC 621.315.592

FREQUENCY CHARACTERISTICS OF METAL-DIELECTRIC-SEMICONDUCTOR (MDS) PHOTOTRANSISTORS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 15, No 10, Oct 81 (manuscript received 1 Jul 80, after final revision 6 Apr 81) pp 2063-2066

FEDORIN, Ye. M., Kiev Polytechnic Institute imeni Semicentennial of the Great Socialist October Revolution

[Abstract] While field-effect phototransistors on MDS structures with an isolated gate and an induced p-channel are widely used in microelectronics as photoreceivers, no data on their frequency characteristics are available. A study was made, therefore, to determine the frequency characteristics of such a device built on n-type silicon with (111)-orientation and electrical resistivity of 4.5 ohm.cm. The gate was made of a translucent low-resistivity SnO_2 layer, and the region under this layer between collector (drain) and emitter (source) served as the photosensitive element. The device was illuminated frontally with radiation at $\lambda = 0.6$ μm coming from an AL-307 light-emitting diode, the gate surface receiving luminous power of the order of 10^{-11} W. The phototransistor was tested in a common-collector circuit and in a common-emitter circuit, with a 3 V supply voltage and a 43 kohm load resistance. In the first case the photovoltage was found to decrease with increasing frequency in the very low range, remaining constant up to approximately 10^3 Hz at a zero bias voltage only. In the second case the frequency characteristic of the photovoltage was found to remain flat up to 10^3-10^5 Hz at any negative bias voltage, with the upper cutoff frequency decreasing from $5 \cdot 10^4$ Hz at $V_g = 0$ to $9 \cdot 10^3$ Hz at $V_g = -6$ V. Figures 2, references 5: 3 Russian, 2 Western.
[67-2415]

UDC 621.315.592

MECHANISM OF FORMATION OF REGIONS WITH DEFECT BUILDUP IN N-TYPE GERMANIUM BOMBARDED BY HIGH-ENERGY PARTICLES

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 15, No 10, Oct 81 (manuscript received 13 Feb 81) pp 2034-2037

POKOTILO, Yu. M., TKACHEV, V. D. and YAVID, V. Yu., Scientific Research Institute of Applied Problems in Physics, Belorussian State University imeni V. I. Lenin, Belorussian Polytechnic Institute, Minsk

[Abstract] An experimental study was made concerning the buildup of defects in germanium doped with antimony upon bombardment by high energy particles. Single crystals of n-Ge<Sb>($N_{Sb}=2 \cdot 10^{14}$ and $3 \cdot 10^{15}$ cm^{-3}) were bombarded respectively with 30 MeV protons, 660 MeV protons, 100 MeV electrons, and

bremsstrahlung γ-quanta of up to 100 MeV. Subsequently the temperature dependence of the lifetime of minority carriers was measured by means of the photomagnetic effect. Also determined were the basic parameters of the model of carrier recombination at defects, namely the hole recombination coefficient, the ratio of electron to hole recombination coefficients, and the potential barrier. An interpretation of the data confirms the role of primary dislocation clusters in forming a stable region of defect buildup. These clusters evidently "disperse" rather than "coagulate" in this case and, upon diffusion, react with impurities forming stable defect complexes. The authors thank V. E. Gusakov for helpful discussion. Figure 1, table 1, references 14: 13 Russian, 1 Western.
[67-2415]

UDC 621.315.592

EFFECT OF ELECTRON BOMBARDMENT ON HEATING OF CURRENT CARRIERS IN $Ge_{1-x}Si_x$ SINGLE CRYSTALS BY ELECTRIC FIELD

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 15, No 10, Oct 81 (manuscript received 27 May 80, after final revision 10 Feb 81) pp 1989-1993

ABBASOV, Sh. M., ABDINOV, A. Sh., ABIYEV, A. K., BAKIKOV, M. Ya., GASUMOV, G. M. and MAMEDOV, V. K., Radiation Research Sector at the Presidium of the AzSSR Academy of Sciences, Baku

[Abstract] An experimental study was made concerning the effect of electron bombardment on the heating and thus the kinetics of current carriers in $Ge_{1-x}Si_x$ single crystals in an electric field. Both n-type and p-type single crystals of $Ge_{0.95}Si_{0.05}$ and $Ge_{0.85}Si_{0.15}$ were grown by the Czochralski process, cut and ground, then etched and rinsed. They were bombarded with 4 MeV electrons at T = 170 K, the integral electron flux density being varied from $3 \cdot 10^{15}$ to $5 \cdot 10^{16}$ cm^{-2}. The current carriers were heated by electric field pulses of microwave frequency and short duration (2 μs) with a low repetition rate not exceeding 6 Hz. The electrical conductivity was measured as a function of the electric field intensity, at temperatures from 77 to 300 K before and after electron bombardment of the specimens. In the case of n-type crystals electron bombardment was found to narrow the temperature range of field dependence of electrical conductivity to temperatures above a critical point, the latter depending inversely on electron flux density. At the saturation level of electron bombardment, moreover, electrical conductivity ceases to be field dependent altogether. In the case of p-type crystals electron bombardment was found not to change the temperature range of field dependence of electrical conductivity but to change the trend of this dependence at low temperatures and to increase the change in electrical conductivity, from that in a weak field to that in a strong field, at high temperatures. The results are interpreted in terms of carrier scattering and entrapment mechanisms. Figures 2, references 9 (Russian).
[67-2415]

USING QUASIHOMOGENEOUS $NbSe_3$ CRYSTALS IN DETECTING AND CONVERTING ELECTROMAGNETIC SIGNALS IN MICROWAVE AND MILLIMETER RANGE

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 20, 26 Oct 81 (manuscript received 8 Jul 81) pp 1235-1238

IVANOV, N. I. and SHCHETKIN, I. S., Physicotechnical Institute of Low Temperatures, USSR Academy of Sciences, Khar'kov

[Abstract] An investigation is made of the nonlinear properties of quasihomogeneous $NbSe_3$ crystals in the millimeter band. The effect of detection and conversion of electromagnetic signals by quasihomogeneous crystals has been observed over a temperature range of 77-300 K. A distinguishing feature of the investigated specimens is that $NbSe_3$ whiskers were produced by solid-phase reaction of massive niobium single crystals placed in a quartz ampule with the stoichiometric proportion of powdered selenium. The nonlinear properties of the whisker crystals were studied in a frequency range of 25-70 GHz. Specimens 5-10 μm in diameter and about 5 mm long were mounted by means of special holders in detectors that were waveguide sections measuring 7.2 x 3.4 mm in cross section shorted by a piston on the end. The power-voltage sensitivity of the specimens to electromagnetic radiation was measured in terms of volts per watt. The power of the detected signal was of the order of 10^{-6}-10^{-9} W with bias current controllable over a range of 0-10^{-4} A. It was found that the power-voltage sensitivity of these crystals is anomalously high at room temperature. It is shown that conversion losses decrease with increasing heterodyne power and with decreasing temperature when these crystals are used in mixers on frequencies of 35 and 57 GHz. The final interpretation of the results requires further experimental and theoretical research. Figures 2, references 5: 1 Russian, 4 Western.
[56-6610]

UDC 537.533.7

COMPUTER EXPERIMENT ON ROTATING CHARGED PARTICLE BEAM BY SINGLE-CRYSTAL SURFACES

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 51, No 10, Oct 81 (manuscript received 14 Oct 80) pp 2151-2152

GOKERMAN, A. F. and CHUBISOV, M. A., Institute of High-Energy Physics, KaSSR Academy of Sciences, Alma-Ata

[Abstract] Two methods are known for rotating charged particles by a crystal surface: 1. with motion of the particles through a bent crystal with capture into a channel resulting in axial or planar channeling; 2. when they are incident at angles θ less than the critical channeling angle and are deflected by the potential field of the crystal surface. In this case, in the first approximation the particles are turned through an angle of 2θ relative to the

[illegible] direction of motion, and [illegible] crystal, [illegible] plates can be used [illegible] the particle beam through an angle [illegible] previous paper, [illegible] experiment was done within the [illegible] molecular dynamics on [illegible] reflection of low-energy hydrogen [illegible] ions by [illegible] crystal [illegible]. The authors now apply this technique to detailed numerical calculation of the rotation of an ion beam by a system of several crystals. The [illegible] applies to reflection of [illegible] ions with energy of 3, 10 and 30 MeV [illegible] surface of silicon in directions [illegible] and [illegible], i.e. for the case of [illegible] "shallow" and "deep" [illegible] surface channels. The Wilson-[illegible] of the ion-atomic interaction potential was used with the Lindhard shielding radius. It was assumed that the charged state of the ion is constant over the path of interaction with the crystal surface. The results of the calculations show that systems of crystal surfaces should be applicable for turning charged particle beams through small angles. References 7: [illegible] Russian, [illegible] Western.
[illegible]

UDC 621.315.592

[illegible] ZINC SELENIDE CRYSTAL FILMS BY PULSED LASER VAPORIZATION

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 5, Sep-Oct 81 (manuscript received 26 Jun 80) pp 121-123

KOREN', N. N., KREMENCK, V. F. and GRIBKOVSKIY, V. V., Institute of Solid State and Semiconductor Physics, BSSR Academy of Sciences

[Abstract] The authors study the feasibility of producing semiconductor films of zinc selenide on single-crystal (germanium, zinc telluride) and amorphous (glass, fused quartz) backings by the method of pulsed laser sputtering in vacuum. The laser used was the GOS-1001 industrial neodymium laser working in the free running regime with emission wavelength of 1.06 μm, pulse duration of [illegible] ms and pulse energy of 80-150 J. The vacuum chamber was a steel bell with [illegible] and [illegible] water cooling. The residual gas pressure in the chamber was [illegible] mm Hg. The specimens were ZnSe powder pellets. The laser beam was incident on the pellet at 45°, and the backings were placed parallel to the surface of the target at a distance of 30-60 mm. An electric furnace was used to vary the temperature of the backings from 297 to 773 K. Electron diffraction patterns showed that polycrystal films are formed on unheated backings with low crystallinity. Raising the temperature of the backings enhances [illegible] crystallization. At a temperature of 713-723 K, grain-oriented zinc selenide films are formed. Analysis shows good coincidence of interplanar spacing with the tabulated values for the cubic modification of zinc selenide. The results of this research are encouraging for further research into techniques for laser sputtering of films and heterostructures with predetermined reproducible properties. Figures 2, references 4 Russian. [illegible]

NONLINEAR INTERACTION OF PICOSECOND LASER PULSES WITH ZnTe SINGLE CRYSTALS

ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 35, No 4, Oct 81
(manuscript received 14 Nov 81 [sic]) pp 618-622

PAVLOVSKIY, V. A., GRIBOVSKIY, V. P., IVANOV, V. A. and PAVLOVSKIY, V. N.

[Abstract] An investigation is made of transmission of a train of picosecond pulses of the second harmonic of a neodymium laser operating in the passive mode-locked state by ZnTe single crystals. As the pulses pass through the specimens, defocusing of the laser beam is observed with selective pulse transmission. Defocusing of the beam is due to variation of the index of refraction of the semiconductor in the excitation region by about -10^{-3}. Selective pulse transmission can be attributed to incoherent phototransition in zinc telluride and to the way that the characteristics of individual pulses depend on their position in the train. Figures 3, references 13: 11 Russian, 2 Western.
[52-6610]

ELECTRIC-DISCHARGE XeF* EXCIMER LASER WITH DISCHARGE STABILIZATION BY ELECTRON BEAM OF LOW CURRENT DENSITY

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 20, 26 Oct 81 (manuscript received 18 Jun 81) pp 1217-1221

BASOV, N. G., DANILYCHEV, V. A., KERIMOV, O. M. and MILANICH, A. I., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] The authors study the threshold and output characteristics of an ExF* excimer laser pumped by a fast discharge at different current densities of the discharge-stabilizing electron beam. The electron beam was coupled into the stainless steel laser chamber through a window measuring 1 x 18 cm covered with aluminum foil 50 um thick. Electron beam current pulse duration was about 50 ns, electron energy was 150 keV, and beam current density was variable from a few mA/cm^2 to several hundred A/cm^2. Discharge was between a stainless steel grid and a brass electrode across a gap of about 1.5 cm. Different mirrors on a 353 nm wavelength were used with reflectivity from 8 to 100% and spacing of 25 cm. Volume of the active region was 0.5 x 1.5 x 18 cm. An investigation of lasing energy as a function of mixture composition ($He:Xe:NF_3$) showed that the optimum pressure of NF_3 is about 5 mm Hg for all mixtures. Gain of the XeF* active medium was about 0.7 cm^{-1} at a pressure of 3 atm for a mixture of $He:Xe:NF_3$ = 350:1.5:1. Maximum energy was 13 mJ at a pressure of 2 atm for mixture $He;Xe;NF_3$ = 350:2.5:1. The results show that the mode of electron multiplication in a fast discharge can be realized beginning with a minimum electron concentration of about 10^{10} cm^{-3}. In contrast to the mode with accumulation of negative ions, the pulse duration of the external ionizing radiation can be considerably reduced to 50 ns. Stabilization of the discharge by an external homogeneous ionizer reduces the load on the foil, increases the laser pulse recurrence rate to tens of kilohertz, and raises the average emission power to several kilowatts. Figures 3, references 7: 3 Russian, 4 Western.
[56-6610]

PYROLYSIS CLEARING WAVE AND OP [illegible]CAL QUALITY OF PHOTODISSOCIATIVE LASER [illegible]

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 19,
12 Oct 81 (manuscript received 9 Jul 81) pp 1160-1164

[illegible]ANILOV, O. B., ZHEVLAKOV, A. P., TUL'SKIY, S. A. and YACHNEV, I. L.

[Abstract] In flashlamp excitation of photodissociative iodine lasers, the optical quality of the working medium is distorted by a gasdynamic compression wave that arises on exposed surfaces and propagates perpendicular to the surface of the pumping source. The resultant gradient-index region absorbs pumping radiation and reduces pumping intensity for gas layers unperturbed by the compression wave. In this paper it is proposed that a pyrolysis clearing wave be used to eliminate the influence of gasdynamic perturbations on lasing characteristics. The absorption of pumping light by the working gas followed by heating and thermodissociation gives rise to the pyrolysis clearing wave. Such a wave can produce the desired effect if it moves faster than the compression wave, and if conditions are such that during lasing in the region covered by pyrolysis there is not time for thermodissociation products to accumulate in quantities sufficient for appreciable absorption of pumping radiation. Experiments were done with the pumping lamp on the axis of the laser chamber. Maximum pumping flux was $1.6 \cdot 10^{23}$ cm^{-2} s^{-1} in the 250-290 nm band. The working gas of the laser was $n\text{-}C_3F_7I$ both with and without SF_6 as a buffer gas. Pumping and lasing pulse shapes were determined as well as the laser emission energy and the field of the stimulated emission on the output mirror of the optical cavity. The results show that flash photolysis produces a clearing wave that propagates from the lamp surface to the wall of the chamber at a rate 3-4 times the velocity of the compression wave under the same conditions. The main lasing energy is radiated by a zone with gradient of the index of refraction not exceeding $2 \cdot 10^{-7}$ cm^{-1} at working gas pressure of 15 mm Hg. Total energy was 650 J with or without buffer gas. Figure 1, references 13 Russian.
[55-6610]

UDC 621.373:[illegible]

[illegible]AL MODELING OF LASING EVOLUTION IN PULSED METAL-VAPOR LASERS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 260, No 4, 1981
(manuscript received 6 Apr 81) pp 853-857

[illegible], [illegible] V., BUCHANOV, V. V., VASIL'YEV, L. A., MOLODYKH, E. I.,
[illegible], V. V. and YURCHENKO, N. I.

[Abstract] A mathematical model is proposed for working processes in pulsed [illegible] lasers as a basis for numerical experiments. Physical formulation of the problem includes excitation, deactivation and ionization by electron impact and by interactions between heavy particles, spontaneous and induced transitions, photoionization and photorecombination, electron-ion recombination

in triple collisions, and particle diffusion. In addition to these processes that are taken into consideration for metal and buffer gas atoms, it is also necessary to account for processes of radiation transport with regard to line contours and possible trapping, as well as dissociative recombination of buffer gas ions. Rate constants of electron-atom collisions are averaged by maxwellian distribution with variable average electron energy, which is found with regard to recombination heating and cooling in the ambipolar diffusion process. It is assumed that the laser is closed to an external electric circuit. A universal program in ALGOL-60 is written for calculating processes in pulsed metal-vapor lasers based on the proposed mathematical description. Examples are given showing the behavior of major parameters of pulse-periodic lasers based on mixtures of Au+Ne, Cu+Ne and Ba+Ne. Figures 4, references 13: 12 Russian, 1 Western.
[40-6610]

UDC 621.373.7

PARAMETRIC LIGHT AMPLIFICATION IN DISPERSIVE MEDIUM WITH MULTIMODE PUMPING

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA in Russian Vol 22, No 5, Sep-Oct 81 (manuscript received 3 Dec 80) pp 6-90

D'YAKOV, Yu. Ye. and NIKITIN, S. Yu., Department of General Physics and Wave Processes, Moscow State University

[Abstract] The authors consider three-frequency parametric interaction of nonmonochromatic waves under conditions where dispersion has a much greater effect on the idle wave than on the signal wave. Conditions are defined under which the idle wave can be considered monochromatic. The roots of the characteristic equation are studied in this approximation, and an exact solution is found for the amplitude equations with consideration of boundary conditions. Analysis of the formulas shows two characteristic modes of parametric light amplification in a dispersing medium: "coherent" amplification that is determined by the average pumping intensity with the spectrum of the signal wave copying that of the pumping wave, and "incoherent" amplification determined by the intensity of the central pumping mode, with only the central component present in the signal wave. The parametric process could be used to produce a tunable quasicontinuum in the long-wave region for spectrometric purposes. As compared with similar applications of stimulated Raman scattering, this technique would have the advantage of the capability for frequency tuning of the quasicontinuum by crystal rotation without changing the pumping wavelength. Figures 2, references 5: 4 Russian, 1 Western.
[47-6610]

UDC 621.378.33

INTERNAL MECHANICAL STRESSES IN (Al, Ga)As HETEROLASERS

Minsk IZVESTIYA AKADEMII NAUK BSSR: SERIYA FIZIKO-MATEMATICHESKIKH NAUK in Russian No 5, Sep-Oct 81 (manuscript received 18 Aug 80) pp 71-75

SOLYAKOV, M. Ye., Institute of Physics, BSSR Academy of Sciences

[Abstract] Residual and thermoelastic stresses caused by temperature gradients are calculated for a typical five-layer structure of (Al, Ga)As heterolasers. The thickness of the separate layers is taken as less than the length and width. Elastic deformation of layers due to the introduction of dislocations during cooling from the growing temperature to room temperature is disregarded since dislocations of nonconformity are not formed for typical concentrations of AlAs in (Al, Ga)As reaching the order of 0.35. The lattice constants of GaAs and AlAs coincide at the growing temperature, and therefore elastic deformation from noncoincidence of the lattice constant at the temperature of growth is also disregarded. It is assumed that there are no external forces. It is shown that with thermal power liberation of 0.5 W, the thermoelastic compressive stresses in the active region of heterolasers with typical dimensions and strip configuration fastened to the heat sink in the p-region is 0.4 MPa. This is two orders of magnitude lower than the residual tensile stresses of the active medium of diodes made without compensation of lattice mismatch, and will reach the residual stress level only when the thermal power reaches 24 W. A comparison of the magnitudes of heterolaser stresses on the initial degradation stage that are due to different factors shows that residual stresses are predominant, and therefore it is insufficient to disregard all but thermoelastic stresses due to the local temperature gradient in any model of formation of a dislocation grid on the early stages of heterolaser operation. Figures 2, references 20: 9 Russian, 11 Western.
[51-6610]

[illegible] FORMATION PHASE FORMATION IN POWERFUL CO_2 LASER WITH SEMI-SELF-MAINTAINED [illegible]

[illegible] PIS'MA ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 18, [illegible] (manuscript received 12 May 81) pp 1096-1100

[illegible], V. F., KARLOV, N. V., KONEV, Yu. B., KONONOV, N. N., KUZ'MIN, G. P. and [illegible], G. K., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences, [illegible]

[illegible] LAU-2 laser facility at Lebedev Physics Institute [illegible] parameters: working volume 270 liters, working mixture CO_2:N:He in atmospheric pressure in proportion 1:1:3, pre-ionization by accelerated electron beam with duration of 1.5 μs, lasing energy 3 kJ in a pulse in the case of a stable cavity, and 1.5 kJ in the case of an unstable cavity. The

[illegible] pulse has the form of a spike with duration of about 150 ns at half-amplitude followed by a tail with duration of about 1 μs. In the best case, about 50% of the energy is concentrated in the spike. To improve this parameter, mixtures without nitrogen have been used. However, this sharply reduces the static voltage across the laser electrodes, resulting in much lower output energy. To maximize the static voltage across the working gap, the helium mixture is doped with trace amounts of an electronegative gas--SF_6. The authors studied the energy and spectral characteristics of laser emission, and also the shape of the laser pulse with various amounts of SF_6 in the working mixture. The results show that the addition of SF_6 can bring the energy characteristics of the laser close to those of the mixture with nitrogen. For SF_6 content of 10^{-3} mm Hg in a mixture of CO_2:He = 1:4, the initial spike contains about 50% of the total energy of the lasing pulse. Spectral measurements show that lasing takes place initially only on the rotational component P_{20}. When SF_6 is added, emission jumps to line R_{14}. Figures 2, references 6: 3 Russian, 3 Western.
[43-6610]

EXCITATION OF STIMULATED MANDELSTAM-BRILLOUIN SCATTERING BY INCOHERENT OPTICAL RADIATION

[illegible] FIZ'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 18, 26 Sep 81 (manuscript received 23 Jul 81) pp 1146-1149

VASIL'YEV, M. V., GYULAMIRYAN, A. L., RAGUL'SKIY, V. V., SEMENOV, P. M. and [illegible]OROVICH, V. O.

[Abstract] An investigation is made of excitation of stimulated Mandelstam-Brillouin scattering by optical emission that is incoherent in cross section. This spatially incoherent optical radiation was produced by focusing a laser beam into an auxiliary nonlinear medium using an array of four lenses. Stimulated Mandelstam-Brillouin scattering was excited in the caustic of each of the lenses of the array. The Stokes waves arising at the caustics of the different lenses fluctuated in phase relative to one another. As a result, the beam of Stokes radiation was made up of four mutually incoherent spectra. This probing beam was sent to a second cell containing carbon disulfide, where it produced the stimulated Mandelstam-Brillouin scattering. The auxiliary nonlinear media were CCl_4 and acetone. In both cases the length of time coherence of the probing beam formed in the first cell was considerably greater than the length of the second cell. In the experiments the energies of the probing radiation incident on the second cell and of the radiation transmitted through it were measured together with the energy of the Stokes wave arising as a result of scattering in the second cell. The spatial structures of the probing radiation entering the second cell and the radiation reflected from it were recorded. The results show that the incoherent stimulating beam is perceived as incoherent only as regards the energy transmitted through the cell. However, excitation of stimulated Mandelstam-Brillouin scattering begins at the same energies as in the case of a coherent beam. This effect may

be due to the small number of components making up the beam, resulting in correlation among the hypersonic structures set up by the beam in the nonlinear medium at different times. Figures 2, references 6: 4 Russian, 2 Western. [43-6610]

UDC 621.378.3

CHARACTERISTICS OF NITROGEN-LASER PUMPED DYE LASER

Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 35, No 4, Oct 81 (manuscript received 16 Jun 80) pp 612-617

DOROFEYEV, S. N., KOZLOV, N. A., KLIMASHINA, A. G., MNUSKIN, V. Ye., TOKAREVA, A. N. and FEDOROV, V. A.

[Abstract] An investigation is made of the emission characteristics of the LZhI-502 dye laser with tuning over a wide spectral range when the Kabel'yero-1 nitrogen laser is used for excitation. The results of the study show a spectral tuning band of 355-730 nm, laser pulse duration of 10 ns or less, radiation divergence close to the diffraction limit at $2.34 \cdot 10^{-3}$ radian and a linewidth of about 0.9 nm for rhodamine-6G when a two-prism selector is used. The linewidth of laser emission can be reduced to 0.1 nm by using a Fabry-Perot interferometer with 100-mm base and mirror reflectivities of 65%. The lower limit of the wavelength band can be reduced to 729 nm by using a KDP crystal for frequency doubling. Figures 3, references 7: 4 Russian, 3 Western. [52-6610]

DEVELOPING TOKOMAK POWER SOURCE

[redacted] in Russian 14 Oct 81 p 3

[redacted] V. Gubarev: "Our Achievements: At the Control Panel of [redacted]"

[redacted] Physicists love to use poetic expressions and paradoxical combinations, and they have quite a good sense of humor. The "black hole" theory was their creation. When the word gets around about the instability of plasma, we begin hearing the phrases "infarct" and [redacted]. And what about the word "Tokomak", which has become so popular? Doesn't it sound like an American Indian word?

Academician B. B. Kadomtsev commented, "Do not forget about psychology. These names, although they sound a bit strange, actually reflect the simplicity and clarity of the physical ideas, which form the basis for controlled nuclear fusion. But they also conceal the unbelievable difficulties, which still must be overcome."

The history of the problem of nuclear fusion over the past quarter of a century has seen periods of most optimistic forecasts and extreme disappointments. They have overtaken each other just as swiftly as this branch of knowledge is developing. Still, there have been new sensational breakthroughs. The most recent sensation took place at the recent 10th European Conference on Controlled Nuclear Fusion and Plasma Physics in Moscow. It consisted of a report, which was given by a group of Soviet scients, on a series of experiments, which are making it possible to take one more step toward the creation of a thermonuclear reactor, which mankind needs so desparately in the near future.

The majority of the physicists who attended the conference believe that in ten years the first fusion reactor will be in operation on a demonstration basis. In this reactor the temperature found within the interior of stars will have been achieved; and, possibly, for the first time ever nuclear fusion will be converted into electrical [redacted].

Let us assume that this happens. At the solemn ceremony commemorating this remarkable power source, recognition will be given to those who saved mankind from his urgent need for power - for then the people of the planet Earth will have an inexhaustible source of power -

[illegible]. They will recognize the contribution of physicists from the Soviet Union, the USA, Europe and Asia, the creators of various power sources, in which the original ideas are embodied, and the inspiration and labor of the most talented scientists of the twentieth century, who devoted themselves to unlocking the secrets of solar power. There is no doubt that the first to be so recognized will be Igor' Vasil'yevich Kurchatov. His lecture in the Center for Atomic Research in Harwell, England, marked the beginning of this joint research effort. Kurchatov was the first to give publicity to the work of the Soviet scientists and to compare thoughts on ways to develop research on nuclear fusion and to appeal for extensive international cooperation.

This was a time of hopes. It seemed that within a very short time plasma would be manageable. Only two years later at the Geneva conference there were heated discussions of ideas for very original power sources, in which stellar plasma must be subjugated. The scientists of various nations followed their own leads. The Americans emphasized the development of stellarators (by the way, this name comes from the Latin "stella", which means "star"). In the Soviet Union we did similar work on such power sources as the "Uragan" in Khar'kov and the "Liven'-2" in Moscow. At the Institute of Atomic Power preference was given to toroidal magnetic separators, which ultimately came to be called the "Tokomak".

And so there was a time of hopes. It seemed that one could build a power source and kindle a manmade star. Then they ran into the nature of high-temperature plasma, of which Academician L. A. Artsimovich said: "The scientists who began work in the field of nuclear fusion and encountered the instability of plasma are in approximately the same situation as the man who for the first time attempts to ride a unicycle even though he has never even seen a common bicycle."

Plasma has demonstrated a multitude of different kinds of instability. It would seem that there is not enough strength to maintain a plasma bunch in a stable condition when it has been heated to tens of millions of degrees. It buckled and splattered on the walls, not wanting to be heated, assumed fantastic shapes, which the experimentors and theoreticians had not suspected. They were unable to come up with a mini-sun. So many different forms of instability were encountered that many physicists gave up. The more incomprehensible forms of instability came to be referred to in gloomy terms as "infarcts" and "insults".

It was at precisely this time of disappointment that I heard Lev Andreyevich Artsimovich say, "I consider myself an optimist. I am convinced that the difficulties will be overcome!"

Somewhat later I read in the book of this outstanding Soviet scientist that, "physicists have run into a problem, which in its difficulty surpasses all other scientific-technical problems that have arrived from the successes of natural science in the 20th century."

At this point the academician added, "there are scarcely any doubts that in the final analysis the problem of controlled thermonuclear fusion will be solved. Nature can only impose a limited number of difficulties to impede progress in solving this problem. After that, man's constant seeking will manage to overcome them. Nature will then be unable to come up with new difficulties."

Under the leadership of L. A. Artsimovich a large group of Soviet scientists has started working on Tokomaks, which the world recognizes as leaders. These Tokomaks will be the basis for the construction of the first thermonuclear reactor.

Tokomak. Of course, there is no American Indian connotation in this word, but the name is simply derived: electrical current (TOK), a magnetic field and a toroidal chamber. These three ingredients finally came to be equated with plasma. The Tokomak-10 power source to a certain extent subjugated plasma to man's will; this immediately gave birth to a new wave of optimism.

It is necessary that the temperature in the reactor of the future reach something on the order of 100 million degrees; in this case to produce energy from without it will be neccessary only to ignite the reaction - from this point on the thermonuclear reactor will burn on its own. But prior to the start of such a reaction the "firewood" will have to be constantly heated and to help them flare up with a bright flame. And this is a complicated task: after all during a one second pulse, for example, the Tokomak-10 requires as much electricity as a small city needs in a 24-hour period.

The plasma pinch does not heat willingly, which creates a barrier on its way to the reactor: how is energy to be fed to the very core of the reactor most efficiently and economically?

And then there was the report at the European conference. It turns out that a group of researchers headed by academician A. V. Gaponov-Grekhov has been working for nearly ten years on high-frequency methods of heating the plasma.

The report on the realization of the electron-cyclotron method of heating plasma was presented at the conference by the laboratory chief of the Institute of Atomic Energy, V. V. Alikayev. In the audience were physicists from Gor'kiy and Moscow, who had also accomplished this remarkable job.

The physics of the process are clear and simple. The electrons in the plasma are rotated at a specific frequency. If an electromagnetic radiation is introduced into the chamber at the same frequency, there is a resonance amplification, which means there is additional heating of the plasma. For this a vibrating gyro generator is required. Its configuration, it would seem, is uncomplicated: an electronic gun in a strong magnetic field shoots a cluster of rotating electrons. Then in a large resonator they are transmitted [illegible] energy into an electromagnetic radiation. The energy is then [illegible]ansmitted through pipes directly into the plasma of the Tokomak.

But this simplicity is deceptive. The Gor'kiy physicists and engineers not only proposed using vibrating gyros and conducted theoretical estimates, but they also designed and manufactured this most complex equipment. Through the joint efforts of the Institute of Atomic Energy and the Institute of Applied Physics they developed the principles of heating plasma. These principles became a reality in the summer of this year. On the Tokomak-10 they made use of the world's most powerful vibrating gyros. The last series of experiments were completed in June. At the congress the scientists reported on the results of their work: a power source rated at 500 KW had "replenished" the plasma; the temperature of the electrons rose to 30 million degrees; and ion heating was registered. Experiments on Tokomaks are being conducted in Leningrad at the Institute of Physics and Technology. The plan of actions is clear - it is necessary to increase the number of vibrating gyros.

The next step toward a thermonuclear reactor was planned.

A new Tokomak-15 power source is now being built; it will be ready in the mid-1980's. Japan's GT-60, the USA's TFTR, and the Jet of the European Society on Atomic Power (Euratom) - all of these are the borthers of the Soviet Tokomaks. Each of these power sources has its own special features. Together they will make it possible to come closer to the creation of the first thermonuclear reactor, which will demonstrate to mankind the enormous discovery potential of these reactors. The creation of such a reactor is no longer a dream but a reality.

Once again the Soviet scientists, just as a quarter of a century ago when I. V. Kurchatov spoke in Harwell, have shown that they are working in behalf of all people on the Earth. In May 1978 Academician Ye. P. Velikhov, the leader of work on nuclear fusion in the USSR, at a conference of the International Agency on Atomic Energy (IAEA) proposed creating a Tokomak-reactor on a joint basis through the efforts of specialists from various nations. The project was given the name INTOR. The council responsible for executing the project is comprised of four men; the Soviet representative on the council is B. B. Kadomtsev.

I asked Boris Borisovich, "Is it true that the first thermonuclear electric power station will be ready no sooner than the 21st century?" The scientist replied, "Even the most pessimistic of us now believe that this will take place by the end of our century." Kadomtsev then added, "I am one of the optimists."

Indeed, things cannot be otherwise in science: only desperate optimists, who work 18 hours a day in laboratories, are capable of kindling stars on Earth.

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MICROSECOND MONOENERGETIC INTENSE ELECTRON BEAM WITH STABILIZED CURRENT

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 20, 26 Oct 81 (manuscript received 20 Jul 81) pp 1224-1227

VORONIN, V. S., ZAKHAROV, S. M., KAZANSKIY, L. N. and PIKUZ, S. A., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] A report on experimental research leading to generation of monoenergetic electron beams (≤400 keV) with duration of up to 8 μs having stabilized current (≤3kA). The experiments were done on a diode with magnetic insulation and pulsed quasi-square wave accelerating voltage. The Marx method was used for generating the accelerating voltage pulses in a seven-stage unit. The pulses had a rise time of less than 5 μs, a flat top with duration of 10 μs, and a gradual trailing edge. A diagram of the diode is shown in the figure. This design is distinguished from conventional coaxial diodes with magnetic insulation in three ways: 1. all maguetic lines of force emanating from the transport channel are closed to electrodes under the cathode potential, completely eliminating counter currents; 2. the inverted design makes all negative electrodes external with the exception of the cathode itself; 3. the diode is compact. Five parameters were recorded in the experiment: accelerating voltage across the diode, total current, current through the collector, current through the solenoid casing, and bremsstrahlung of the beam on the collector. Oscillograms show approximately 10% current stability and energy homogeneity of the electron beam for nearly 3 μs at an accelerating voltage of 370 kV, and for nearly 5 μs at 270 kV with a cathode-anode gap of 5 mm. Current pulse duration is increased to 8 μs with a 20 mm gap at accelerating voltage of 270 kV, although this is detrimental to current stability and reproducibility of results. Figures 2, references 4: 3 Russian, 1 Western. [Figure on following page.]

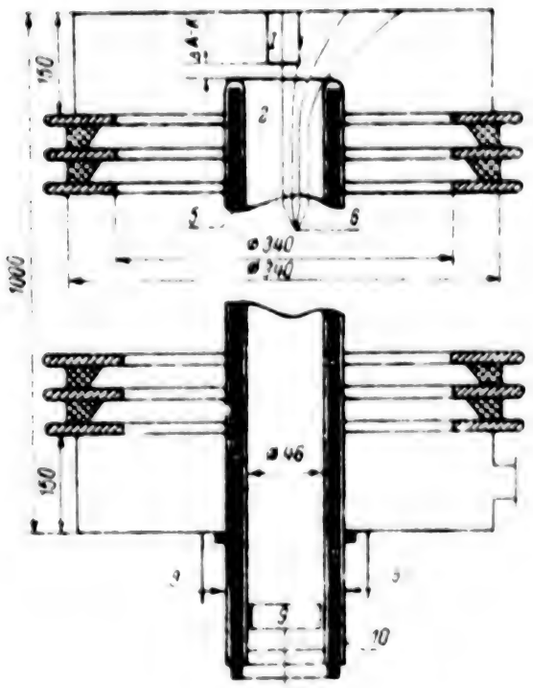

Diagram of diode: 1--cathode; 2--transport channel; 3--gradient ring; 4--dielectric ring; 5--solenoid; 6--magnetic lines of force; 7--branch pipe for evacuation; 8--adjustment screws; 9--collector; 10--solenoid vacuum jacket

[36-6610]

GENERATING INTENSE LOW-ENERGY NANOSECOND ELECTRON BEAMS

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 20, 26 Oct 81 (manuscript received 17 Mar 81, after revision 3 Jul 81) pp 1227-1230

[AOVAL', B. A., MESYATS, G. A., OZUR, G. Ye., PROSKUROVSKIY, D. I. and YANKELEVICH, Ye. B., Institute of High-Current Electronics, Siberian Department, USSR Academy of Sciences, Tomsk

[Abstract] The paper gives the results of studies of an explosive-emission source of electrons for technological purposes. The electron beam is shaped in a diode with cathode-anode gap of 0.1-0.3 cm by discharge of a capacitive accumulator (C = 6 nF) through a transmission line with wave impedance of 8 ohms.

voltage pulse rise time is 3-5 ns. The cathode is made of graphite, and the anode is a tungsten or molybdenum grid with transparency of about 60%. Experiments were done to determine the distribution of average current density over the cross section of the beam in a longitudinal magnetic field ranging from 0 to $5 \cdot 10^5$ A/m. Residual gas pressure in the chamber was about 10^{-5} mm Hg. It was found that there is an optimum mangetic field strength that maximizes uniformity of current distribution over the cross section of the beam. Minimum scatter of beam current from pulse to pulse is observed in fields of $2 \cdot 10^5$ and higher. Current transmission through the drift space cannot be described by a 3/2 law because of the considerable influence of ions of the anode and collector plasma, and because of longitudinal and radial fall-off of potential in the beam. Figures 3, references 8: 6 Russian, 2 Western.
[68-8815]

UDC 537.533

[illegible] GENERATING VOLUMETRIC GAS DISCHARGE

[illegible] ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 51, No 10, Oct 81 [illegible] (last received 1 Aug 80) pp 2032-2037

[illegible], G. V. and SAMYSHKIN, Ye. A., Institute of Optics of the Atmosphere, Siberian Department, USSR Academy of Sciences, Tomsk

[Abstract] Experimental studies are done on the amplitude-time characteristics of electron beams generated in a low-current pulsed volumetric discharge. The flat (16) duralumin cathode had a working area of about 50 mm^2. The flat anode grid was made of wire 30 μm in diameter with spacing of 150 μm between wires. The electron beam collector was situated about 32 mm from the anode. Interelectrode gaps of 0.5, 0.75 and 1 mm were studied. The working gas was nitrogen at a pressure of 0.1-13. kPa. Capacitance of the discharge capacitor ranged from 20 to 270 pF, and the charging voltage was 3-12 kV. A screen grid with geometric transparency of 99% was placed in the anode-collector drift space parallel to the anode at a distance of 3 mm. This enabled separate registration of discharge current pulses across the cathode-anode gap, and the current of completely decelerated runaway electrons in the drift space drawn to the anode by the space charge that they form. It is demonstrated that there may be a transitional stage of the volumetric pulsed discharge that generates an electron beam with efficiency of nearly 100%, and such a stage is experimentally realized with efficiency of runaway electron generation of 80-85%. This is not a glow discharge, as there is no pronounced region of cathode potential drop. Preliminary illumination of the discharge has a considerable effect on development and maintenance of this stage. The efficiency of electron beam shaping in the discharge is considerably dependent on the electric parameters of the discharge loop and the accelerating gap. Figures 4, references 8: 7 Russian, 1 Western.
[68-8815]

STUDYING LASER EMISSION SCATTERING WITH OBLIQUE INCIDENCE ON PLASMA

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 18, 26 Sep 81 (manuscript received 30 Apr 81) pp 1109-1113

ANDREYEV, A. A., MEDVEDEV, R. N., SOLOV'YEV, N. A. and SHATSEV, A. N.

[Abstract] Laser-driven fusion research has prompted interest in radiation scattered by laser plasma. In this paper the authors investigate the energy and spectral characteristics of specularly scattered and backscattered radiation as a function of the angle of incidence in the plane of polarization of the heating radiation, enabling reconstruction of the averaged hydrodynamic parameters of the plasma. Experiments were done with a neodymium laser working in the mode-locked regime with pulse duration of 0.2 ns, and wavelength of 1.06 [illegible]. Radiation was focused on a massive polyethylene target. Flus densities of 10^{13} and 10^{14} W/cm^2 were studied. Emission scattering had two pronounced components: specular and backscattered. The spectrum of the specularly scattered component is broadened by about 15 Å and its emission spectrum is shifted toward the blue by -2 A. It is assumed that the main contribution to this scattering is from the specularly reflected emission component shifted and broadened relative to the incident radiation due to unsteadiness of the plasma and the finiteness of the focusing angle. The spectrum of the backscattered radiation is broadened to 25 Å at half-amplitude. The spectrum of the backscattered radiation also shows intensity modulation with characteristic period of 5-7 Å. The spectral and energy characteristics of the backscattered radiation are interpreted in terms of the convective model of instability of stimulated Mandelstam-Brillouin scattering. It is found that the coefficient of back reflection depends on the polarization of incident radiation analogously to the mirror coefficient of reflection. In both cases a minimum is observed in the vicinity of an angle of incidence of 22.5°. This apparently shows the influence of linear transformation on stimulated Mandelstam-Brillouin scattering. Figures 2, references 10: 8 Russian, 2 Western.
[43-6610].

UDC 621.384.62[illegible]

PLASMA DIODE AS SOURCE OF INTENSE FAST NEUTRON PULSES

Moscow ATOMNAYA ENERGIYA in Russian Vol 51, No 1, Jul 81 (manuscript received 9 Jan 80) pp 19-23

[illegible], N. I., TSUKERMAN, V. A., VOLODIN, M. D., [illegible], [illegible], [illegible], V. L., LYAMIN, V. A. and PILIPENKO, A. V.

[Abstract] The article gives the results of research done in 1965-[illegible] on producing intense neutron pulses on two direct-action accelerators: [illegible]-3000 and ORIEN-1. Direct discharge of a capacitor bank with energy [illegible] kJ across a diode with magnetic insulation and spark ion sources produces

a neutron yield of up to 10^{10} neutrons per pulse (GI-3000). In the ORION-1 accelerator with storage energy of 380 kJ, the plasma state is reached by charging the inner line through discharge in the diode. For energy storage in a double shaping line of 40 kJ when beam pinching is used, the yield is 10^{11} neutrons per pulse in the reaction $^{7}Li(d, n)$. The role of an ion group with anomalously high energy is demonstrated. The outlook for increasing the fast neutron yield is discussed. Figures 3, references 18: 11 Russian, 7 Western.
[45-6610]

UDC 621.384.326.22.536

PYROELECTRIC BREMSSTRAHLUNG PULSE DETECTORS

Moscow ATOMNAYA ENERGIYA in Russian Vol 51, No 1, Jul 81 (manuscript received 9 Jun 80) pp 37-40

SIRAKOVSKAYA, R. Ya. and KREMENCHUGSKIY, L. S.

[Abstract] The authors investigate the possibility of using pyroelectric detectors as exposure dose radiation monitors in registration of accelerator bremsstrahlung pulses (directional flux) of high intensity and short duration. In calculating the response of the detector to pulsed emission it is assumed that the sensing element in absorbing penetrating radiation reacts uniformly, and that the pyroelectric detector is a system with lumped parameters. Heating and cooling are described by heat balance equations. The pulses are assumed to be short enough that heat losses can be disregarded, and the conditions of operation of the detector can be taken as quasi-adiabatic. The equivalent detector circuit is made up of the capacitance of the detector and the load resistance connected in parallel to a pyroelectric current generator. Expressions are derived for the sensitivity of the detector as a function of radiation energy. Consideration is taken of the influence of current induced by Compton electrons. It is shown how detectors can be designed to minimize the Compton effect. Pyroelectric detectors are tested by measuring nanosecond pulses, and the experimental results agree satisfactorily with the calculations. Figure 1, references 7 Russian.
[45-6610]

UDC 532.6.696

INTRODUCING HYDROGEN INTO PALLADIUM AND TITANIUM UNDER ACTION OF LOW-VOLTAGE GLOW DISCHARGE

Moscow ATOMNAYA ENERGIYA in Russian Vol 51, No 1, Jul 81
(manuscript received 31 Jul 80) pp 57-58

RADZHABOV, T. D., ALIMOVA, L. Ya., DYSKIN, V. G., MELKUMYAN, F. Sh., SKORODUMOV, B. G., RADYUK, T. A., KADUSHKIN, V. N. and TRINKIN, I. I.

[Abstract] Measurements are made of the content and depth distribution of hydrogen in polycrystalline specimens of titanium and palladium under the action of low-energy hydrogen ions (glow-discharge plasma). Specimens were irradiated with a dose of 10^{20} cm^{-2} at a potential difference across the electrodes of 500 V, discharge current density of 10-100 mA/cm^2 and hydrogen pressure in the working chamber of $1.3 \cdot 10^2$-$3.3 \cdot 10^3$ Pa. The profile of distribution of hydrogen in the specimens was measured on an extracted beam of 20 MeV protons of a 1.5-meter cyclotron by a coincidence technique: the energy of a proton scattered by hydrogen in the specimen was determined along with that of the corresponding recoil proton. The specimens were made of cold-rolled foil 20 and 60 μm thick. The results show that a region of enhanced concentration of interstitial hydrogen is formed by ion implantation in materials with low thermal sorption capacity (palladium), but not in targets with high sorption capacity (titanium). The elastic stresses resulting from the interstitial hydrogen lead to blistering and erosion of the surface. The ion-implanted hydrogen in titanium is bound in hydrides, and can be desorbed only at elevated temperatures of the order of 500° C or more. On the other hand, no such compounds are formed in palladium, and the hydrogen can be desorbed even at low temperatures. Figures 2, references 6: 5 Russian, 1 Western.
[45-6610]

UDC 621.315.592

OPTICAL VARIBAND FILTER WITH CONTROLLABLE PASSBAND

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 15, No 10, Oct 81 (manuscript received 6 Jan 81) pp 1928-1933

BYVALYY, V. A., DMITRIYEV, A. G., SELIVANOV, P. I., TSARENKOV, B. V., UKHANOV, Yu. I. and YAKOVLEV, Yu. P., Leningrad Polytechnic Institute imeni M. I. Kalinin, Physico-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] The feasibility of using semiconductors with a forbidden band whose width varies along one crystal coordinate as optical filters with a controllable passband has already been established. Here the performance of such a filter is examined from the phenomenological standpoint. The spectral characteristic of the transmission coefficient is calculated for a plane-parallel semiconductor plate, assuming negligible reflection, and found to depend on the width of the incident light beam as well as on its angle of incidence and the location of its point of incidence. In the dependence of the transmission coefficient on the energy of incident photon one can, furthermore, distinguish a low-energy range and a high-energy range with different characteristics and an intermediate transition range between them. The boundary of the low-energy range is adjustable, it depends on the geometrical parameters of the incident light beam. The practical implementation of these features is demonstrated on a $Ge_{1-x}Al_xAs$ device which has been produced experimentally by liquid epitaxy and subsequently tested in monochromatic light from a KIM-8 incandescent lamp. Figures 3, references 2 Russian. [67-2415]

UDC 535.317

INTERPRETING SPECKLE INTERFERENCE PATTERNS OF DISPLACED AND STRAINED OBJECTS

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 51, No 10, Oct 81
(manuscript received 7 Dec 79, after revision 25 Sep 80) pp 2080-2085

KLIMENKO, I. S., KVARATSKHELIYA, T. G., VOLKOV, I. V. and GOLIKOVA, N. A.,
Moscow Physicotechnical Institute, Dolgoprudnyy, Moscow Oblast

[Abstract] An analysis is made of processes yielding speckle interference patterns of objects undergoing deformation and rigid displacement. A method is proposed for interpreting speckle interference patterns produced by spatial filtration of the scattered field at an arbitrary distance from double-exposed speckle photographs of strained and displaced objects of various kinds in different combinations. It is shown that in the case of uniform rigid displacement the corresponding speckle interference pattern is observed with filtration at distances much greater than the focal length, but is not differentiated with filtration in the frequency plane. In this case (filtration in the frequency plane) a speckle interference pattern) is formed that corresponds to displacement with rotation or deformation of the object. Therefore, the field of a double-exposure hologram can yield speckle interference patterns corresponding to pure uniform displacement, and to pure strain as a result of filtration done sequentially in the far zone and in the focal plane.
Figure 1, references 7: 1 Russian, 6 Western.
[58-6610]

UDC 513.82.517.9

DETERMINING OPTICAL BODY LOCATED IN HOMOGENEOUS MEDIUM FROM ITS IMAGES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 260, No 4, 1981
(manuscript received 27 May 81) pp 799-803

LAVRENT'YEV, M. M., associate member, USSR Academy of Sciences,
GEREVTSOV, Ye. Yu. and SHARAFUTDINOV, V. A., Computing Center, Siberian Department, USSR Academy of Sciences, Novosibirsk

[Abstract] In an earlier paper [V. R. Kireytov, DOKLADY AKADEMII NAUK SSSR, Vol 252, No 1, 1980, p 27] the concept of the photopotential was introduced for a broad class of distributions of optical sources situated in an arbitrary (inhomogeneous, anisotropic, absorbing) medium. This idea is the geometric-optics formalization of a photographic image: the photopotential of distribution J at point x is the photograph of J taken from point x. Kireytov's paper raised the question of finding the minimum set with distribution uniquely determined by values of the photopotential at points in this set. The authors of this paper examine this problem in the simplest case where the medium is homogeneous, isotropic, non-absorbing, and the distribution is steady-state,

consisting of spherically symmetric sources. An examination is made of the special case of determining the distribution of optical sources in an arithmetical two-dimensional euclidean space where distribution J has a carrier concentrated on a section of some smooth curve. References 5: 4 Russian, 1 Western.
[40-6610]

INFRARED QUENCHING OF PHOTOCONDUCTIVITY AND HOLOGRAPHIC RECORDING IN BISMUTH SILICATE

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 23, No 10, Oct 81
(manuscript received 26 May 81) pp 3110-3116

KAMSHILIN, A. A. and PETROV, M. P., Physico-Technical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] Owing to their outstanding photoconduction and electro-optical characteristics, $Bi_{12}SiO_{20}$ crystals are used as reversible media for holographic data recording and as the principal elements in PROM and PRIZ space-time modulators of light. Bismuth silicate is a dielectric with wide energy gap of 3.25 eV. An experimental study has demonstrated that preliminary exposure of such a crystal to infrared radiation will quench its photoconductivity in the blue-green range of the spectrum and modify the characteristics of the holographic process. Infrared irradiation and the resulting initial drop of photoconductivity cause a transient increase of diffraction efficiency, its maximum level reached depending on the duration and intensity of that irradiation. An analysis of the phenomenon, based on the energy-band structure of possible electron transitions as well as on the carrier diffusion and drift processes, reveals nonequilibrium energy distribution of electrons trapped at impurity levels and nonsteady quenching of photoconductivity. The transient increase of diffraction efficiency can be explained only by bipolar carrier diffusion, which also raises holographic sensitivity. The length of the diffusion path can be estimated, accordingly, from the dependence of holographic sensitivity on space frequency of holograms:

$$S \propto \alpha\beta I_0 \frac{\tau Dk}{1+k^2D\tau}$$

(I_0 - intensity of recording light, α - absorption coefficient, β - quantum yield, τ - lifetime of conduction electrons, D - diffusion coefficient for free charge carriers, k - space frequency of hologram). The authors thank M. G. Miteva for assisting with the experiments, also S. I. Stepanov and A. I. Grachev for helpful discussions. Figures 5, table 1, references 8: 3 Russian, 5 Western.
[08-2415]

ACOUSTO-OPTICAL CONVOLVER BASED ON INTEGRATED OPTICS ELEMENTS

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 19, 12 Oct 81 (manuscript received 26 Jun 81) pp 1200-1203

AKSENOV, Ye. T., KUKHAREV, A. V., LIPOVSKIY, A. A. and PAVLENKO, A. V., Leningrad Polytechnical Institute imeni M. I. Kalinin

[Abstract] An important area in development of integrated optics is production of devices for acousto-optical processing of radio signals, and specifically correlators and convolvers. The diagram shows an integrated device for correlational signal processing. The principal elements of the device are a planar optical waveguide, converters that change electric signals to surface acoustic waves, waveguide lenses, a light source and a photocell. In this paper the authors study a convolver made up of integrated and volumetric components in a unified structure. The planar optical waveguide, converters and waveguide lens were formed on a single substrate, The laser light source and photocell (helium-neon laser and PIN-photodiode) were external elements. The substrate was a Y-cut lithium niobate plate measuring 25 x 15 x 3 mm. The planar optical waveguide was made by titanium diffusion in an airstream (titanium film 40 nm thick, diffusion time 6 hours). Attenuation of light in this waveguide does not exceed 1 dB/cm. The waveguide lens was formed by a depression in the substrate 10 mm in diameter and 0.7 mm deep, and had a focal length of 70 mm. Slit converters were used to excite surface acoustic waves. Experiments showed that the working frequency band at half power is 110 MHz with losses on conversion not exceeding 12 dB. When square-wave radio pulses are sent to the inputs of the piezoelectric converters, a triangular pulse that is the convolution of the initial pulses is recorded at the output of the photocell in the region of the first diffraction order. Figures 2, references 4: 3 Russian, 1 Western.

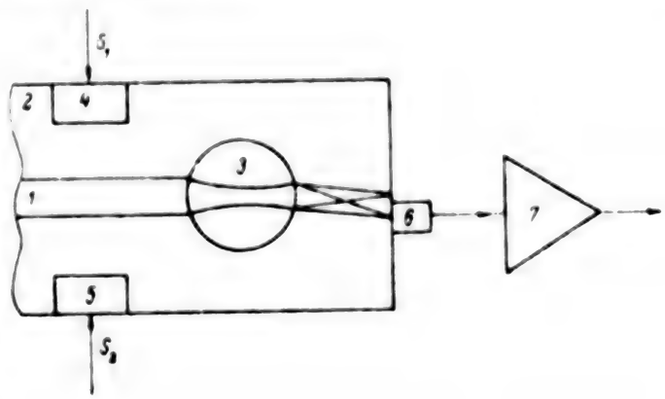

Diagram of integrated acousto-optical convolver: 1--beam from light source; 2--planar optical waveguide; 3--waveguide lens; 4, 5--piezoelectric converters; 6--photocell; 7--rf amplifier

[55-6610]

SHOCK WAVE STRUCTURE IN WEAKLY IONIZED NONISOTHERMAL PLASMA

Moscow PIS'MA V ZHURNAL EKSPERIMENTAL'NOY I TEORETICHESKOY FIZIKI in Russian Vol 34, No 9, 5 Nov 81 (manuscript received 29 Jul 81) pp 485-488

AVRAMENKO, R. F., RUKHADZE, A. A. and TESELKIN, S. F., Moscow State University imeni M. V. Lomonosov

[Abstract] An analysis is made of uniform induced motion of the charged component of a weakly ionized plasma. It is assumed that the motion is caused by a relatively weak (non-ionizing) shock wave propagating through the neutral component of the plasma. Since the velocity of ion-sound waves is much greater than the thermal velocity of ions and the speed of sound in the neutral component, the shock wave may produce leading ion-sound waves that perturb the charged component of the plasma in advance of the shock wave front. The authors examine the resultant complex nonlinear motion in the one-fluid hydrodynamics model. It is shown that the structure of the perturbation of the charged component resembles that of a shock wave when $\ln[(\rho_{n1} - \rho_{n0})/\rho_{n0}] > 1$, where ρ_{n0} and ρ_{n1} are the neutral gas densities preceding and following the shock wave front respectively. Analytical expressions are derived for the density profiles and the velocity of the charged component. Figure 1, references 5: 4 Russian, 1 Western.
[57-6610]

GENERATING NEGATIVE IONS IN DIODE WITH MAGNETIC INSULATION

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 20, 26 Oct 81 (manuscript received 20 Jul 81) pp 1258-1262

AGAFONOV, A. V., LEBEDEV, A. N. and ORLOV, D. B., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] So far, the development of negative ion sources based on using conventional sources of positive ions and charge exchange sources has yielded H^- currents that do not exceed 0.1 A. At the same time, the use of high-current high-voltage diodes to produce positive ions has brought beam intensity almost to the megampere range in a matter of a few years. In this paper the

authors point out analogous capabilities for generation of negative pulsed ion beams. The analysis is based on a model of a flat diode formed by two parallel conductive planes separated by distance d. The diode is placed in an external magnetic field B_0 directed parallel to the surfaces of the electrodes (y-axis) that is homogeneous until the emission current appears. It is assumed that the ionic and electronic fluxes are homogeneous in the y and z directions. The x-axis is taken as normal to the electrode surface. Negative ions extracted from the cathode plasma cross the interelectrode gap without being deflected by the magnetic field, while electrons are turned back to the cathode by this field, i.e. the diode has magnetic insulation with respect to electrons. Absence of an electronic component of the current sharply enhances the working efficiency of the device since all the energy of the source is transferred to ions. A system of equations is given that describes the equilibrium states of fluxes, assuming that all emitted electrons are returned to the cathode. These equations are numerically solved with the assumption that all times are much shorter than the time of penetration of the intrinsic magnetic field of the beam into the metal electrodes, which corresponds to the condition of conservation of magnetic field flux when emission appears, and with boundary conditions corresponding to space-charge limited electron and ion emission currents. The results show that ion currents can be generated that are comparable with the space-charge limit in such a diode under realistic conditions. For a given external magnetic field flux, there is an optimum voltage across the diode that maximizes the ion current. Beams of heavy negative ions should be producible by using a plasma formed by halides with high electron affinity. Although the proposed model implies that the current density of heavy ion beams must decrease in proportion to the square root of the mass of the ions, this reduction is only about an order of magnitude even for the heaviest halide, so that a bromine plasma should yield a beam with intensity of the order of amperes per square centimeter if there are no light negative ions present. Figures 2, references 5: 3 Russian, 2 Western.
[56-6610]

SELF-FOCUSING OF IONIC LANGMUIR WAVE BEAMS

Leningrad PIS'MA V ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 7, No 10, 12 Oct 81 (manuscript received 5 Jun 81) pp 1177-1181

MOISEYEV, S. S. and SHUKLIN, A. P.

[Abstract] Previous research has shown that an ionic Langmuir wave is modulationally stable in a plasma consisting of ions and electrons. This is due to the stabilizing action of the second harmonic on the first. In this paper, it is shown that the conclusion of stability is valid when the amplitude of the Langmuir wave does not exceed a certain value, and the characteristic dimension of the region of field localization considerably exceeds the Debye radius of electrons. However, transport of short-wave Langmuir oscillations in a rarefied plasma with hot electrons can easily give rise to a situation where the characteristic transverse dimension of the beam is less than

the Debye radius of the electron. An analysis is made of the feasibility of self-focusing of beams of short-wave ionic oscillations. The analysis is based on a system of equations of two-fluid quasihydrodynamics and Poisson's equation. It is shown that compression of such wave beams with arbitrary potential distribution over the cross section takes place in the quasi-two-dimensional state, and an equation is derived that describes this compression. Conditions of existence of a solution of the equation are given. References 4: 3 Russian, 1 Western.
[55-6610]

UDC 537.525

EXPERIMENTAL STUDY OF LOW-VOLTAGE CESIUM ARC PLASMA CONDITION AT HIGH DEGREES OF IONIZATION

Leningrad ZHURNAL TEKHNICHESKOY FIZIKI in Russian Vol 51, No 10, Oct 81 (manuscript received 7 Aug 80) pp 2038-2042

MIRZABEKOV, A. M., MITROFANOV, N. K., OSTROVSKIY, Yu. I. and SHEDOVA, Ye. N., Physicotechnical Institute imeni A. F. Ioffe, USSR Academy of Sciences, Leningrad

[Abstract] Experiments were done to study the local ionization state in a low-voltage arc plasma at high degrees of ionization. The plasma was produced by a low-voltage (U < 10 V) cesium arc of millisecond duration struck between a thermionic cathode at 1000 K and a flat anode of the same surface area (1 cm^2) spaced a distance of 3-10 mm apart at vapor pressures of 0.5, 1.0 and 2.0 mm Hg in discharge currents of up to 50 A. Resonant holographic interferometry was used to measure the distribution of cesium atom concentration in the ground state. These measurements were made with an optically pumped dye laser and a Mach-Zehnder interferometer. Electron temperature and charged particle concentration were spectroscopically determined from the intensity and spectral distribution of the recombination 6P continuum of cesium. The resultant data on concentration of atoms were compared with equilibrium values calculated from experimental electron temperatures and concentrations by the Saha formula. The results show that the low-voltage cesium arc plasma is in the strongly ionized state as soon as the current density exceeds 10 A/cm^2. The ionizational equilibrium was not appreciably disturbed up to distances of the order of the electrode diameter from the discharge axis. Figures 5, references 8: 7 Russian, 1 Western.
[58-6610]

PERFECTION OF SMALL PARTICLES OF TITANIUM OXYNITRIDES

Leningrad FIZIKA TVERDOGO TELA in Russian Vol 23, No 10, Oct 81
(manuscript received 3 Mar 81, after final revision 25 May 81) pp 3082-3086

DOMASHNEV, I. A., TORBOVA, O. D., BERESTENKO, V. I. and TROISTSKIY, V. N.,
Institute of New Problems in Chemistry, USSR Academy of Sciences,
Chernogolovka (Noginskiy Rayon, Moscow Oblast)

[Abstract] A study was made to determine the dependence of the superconductivity characteristics of polycrystalline titanium oxynitrides on their oxygen content. Titanium oxynitrides were produced by hydrogen reduction of titanium tetrachloride in a nitrogen plasma, with O:Ti ratio varied from 0 to 4.13 wt.% ($TiN_{1-x}O_x$, $0 \leq x \leq 0.16$). Measurements were performed on two series of specimens: suspensions of small granular particles 1.0 vol.% in paraffin produced by ultrasonic treatment, and almost nonporous compact agglomerations of 50 μm particles produced by sintering of powder at 1700 K with subsequent annealing at that temperature for 5 h. The temperature dependence of superconducting transition in granular particles was determined from the change of the diamagnetic moment in a magnetic field of 0.03 T. The dependence of critical temperature and field intensity as well as of field penetration depth and Ginzburg-Landau parameter on oxygen indicate that stoichiometric titanium mononitride without oxygen is a type-I superconductor. Varying the vol.% of particles and oxidizing their surface did not result in significant changes in superconductivity characteristics, indicating absence of any size effect. Figures 2, table 1, references 15: 8 Russian, 7 Western.
[68-2415]

UDC 535.231.6

LIMITING SENSITIVITY OF THERMAL RADIATION RECEIVERS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA
in Russian Vol 22, No 5, Sep-Oct 81 (manuscript received 31 Aug 79) pp 31-35

BRAGINSKIY, V. B., BUCHNER, J., East Germany, and VORONTSOV, Yu. I.,
Department of Physics of Waveforms, Moscow State University

[Abstract] Sensitivity of thermal radiation receivers is limited by effects such as fluctuations of heat exchange of the heat-sensing element with the thermostat and fluctuations of background energy flux that are inherent in all receivers, and also by electrical noises, heating of the sensing element by measurement current (in bolometers) and friction (in receivers with thermomechanical effect) that are characteristic of the physical peculiarities of the receiver and the method of measuring the temperature of the receiving element. In this paper the authors consider the specific limits of sensitivity of the most promising thermal radiation receivers that can be operated under conditions of deep cooling: dilatometric radiation receivers, and superconducting and semiconductor bolometers. It is shown that even at temperatures of 4 K, the instrumental limits of dilatometric thermal receivers and superconducting bolometers may be lower than the potential limit due to fluctuations of heat exchange between the heat-sensing element and the ambient medium. The instrumental limit of sensitivity of semiconductor bolometers at low temperatures is higher than the potential sensitivity limit. The authors determine the level of the noise temperature of amplifiers that permits attainment of potential sensitivity. Figure 1, references 10: 5 Russian, 5 Western.
[47-6610]

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